

Aviation Week & Space Technology

75 cents

Mid-December, 1963

Buyers
Guide
Issue

A McGraw-Hill Publication

Titan 2 Silo Launch





Historical Wheeler Solar Chronometer. Courtesy, U.S. Naval Observatory.

from solar chronometer to space booster guidance

The Wheeler Solar Chronometer was designed to indicate true sun time and longitude, with corrections for the sun's position and the earth's position. Highly accurate though it was, the instrument had the basic flaw of all sun data: it was utterly worthless when the sun went down.

To avoid the possibility of being in the earth's shadow, space launch vehicles require guidance systems capable of determining position, bias without solar observations. This requires advanced navigational systems of unparalleled accuracy—AC accuracy.

AC is presently supplying its Titan III inertial guidance system for application in the Titan III. And AC has recently been selected to produce the navigation guidance system for NASA's Apollo command module. Added to these current programs, AC's outstanding performance on the Thor, Atlas, Regulus and Polaris

missile programs and its work in preceding navigation equipment for manned aircraft have established AC as a leader in the field of navigation and guidance.

AC's ability to design, develop and produce highly accurate guidance and navigation systems at low cost is unique. Put it to work for you. Contact Director of Sales, AC Spark Plug Division, General Motors, Milwaukee 2, Wisconsin.



MASTER NAVIGATORS THROUGH TIME AND SPACE
INERTIAL AND NAVIGATION FOR BALLISTIC,
MISSILE AND SPACE VEHICLES, AND
SATELLITES DELIVERED ON TIME AT LOW COST
IN CUTTING-EDGE DESIGN AND RELIABILITY

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SPECIFY STRATOFLEX FOR EVERY HYDRAULIC & PNEUMATIC LINE REQUIREMENT

Stratoflex offers hose, fittings, and hose assemblies in a wide range of sizes and types, allowing engineers exceptional freedom in equipment design for aircraft, missiles and ground support systems. Stratoflex flexible hose and fittings are available for hydraulic and pneumatic applications in a wide pressure range. High pressure Super-T-HP® Teflon® and medium pressure Super-T Teflon® hose assemblies are designed for extreme temperature applications. High Density Polyethylene hose assemblies are designed for pneumatic applications on ground support systems to operate up to 8,500 psi. SF 156 Hose assemblies are designed for special hydraulic and engine fuel and oil systems. Hose assemblies shown below conform in every detail to specifications listed.

*For increased information, see page 10.



113026-S-L
(“113”) Hose up to 60% lighter than conventional
MIL-H-8794

112.313-313-S-L
MS 26759 Hose Assembly
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MIL-H-8788 Hose



SPECIAL CONFIGURATIONS
Shows here are a few of the many different configurations Stratoflex has supplied in industry.



111-812-812-S-L
MS 26741, MS 24587
(MIL-H-8795) Hose Assembly
MIL-H-8794 Hose



199-811-331-S-L
AN-6270 Hose Assembly
MIL-H-5693 Hose



148-811-331-S-L
AN-6270 Hose Assembly
MIL-H-5693 Hose

Write for free brochure, "Stratoflex & Specialty Catalog, 1975," or call Stratoflex at 312/227-5000.

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TOTAL PERFORMANCE of military aircraft and missile systems depends on component performance and reliability. For rotary power functions, hydraulic damping and vibration control, leading airframe and missile contractors specify Houdaille hydraulic equipment.



FLUTTER DAMPERS — An original Houdaille design, these compact rotary valve type dampers offer the best solution to high frequency vibration problems on aircraft control surfaces. Applications include the Republic F-105 and McDonnell's F-4H and F-101.



VISCOUS SHIMMY DAMPERS — The shearing action of highly viscous fluid provides effective shimming damping, with 360° rotation, on all types of castoring landing gear. The Sikorsky S-64 "Flying Crane" and Vertol V-107 H and HRB 1 utilize Houdaille viscous dampers.



CONTROLS DAMPERS — For a variety of control system applications, these specially engineered units provide positive hydraulic damping for such functions as elimination of stick vibration and feedback, and limiting of pilot control input. Shown are the stick damper for the Raisman HU2 K and other typical designs.



HYDRAULIC ROTARY ACTUATORS — Designed for direct rotary torque output, without linkages or feedback, Houdaille actuators perform such functions as powering airborne radar scanners and raising and lowering radar antennae on mobile missile launchers.

WHETHER YOUR PROBLEMS involve airborne hydraulic applications or ground handling systems, look to Houdaille for the answers. Write for our descriptive booklet showing Houdaille's complete facilities and products, or send details of a special problem to ...



HOUDAILLE HYDRAULICS

PROVEN BY PERFORMANCE IN
**AIRCRAFT
AND MISSILE
APPLICATIONS**



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Specialists in Aerospace damping and vibration control

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Plexiglas®

aviation - industrial - transportation plastic



Crew helmets and side windshield panels on the McDonnell Phantom II are made of stretched PLEXIGLAS® 88 acrylic plastic. The Phantom II is the world's fastest all-weather jet fighter, now being built for Navy, Marine Corps and Air Force use.

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ROHM & HAAS
INTERPLASTICS INC.

WHERE THERE'S PROGRESS, THERE'S PLEXIGLAS®

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PAYMOVER®

Blade turns PAYMOVER® into effective snow fighter

With only a minimum investment for this straight snow clearing blade, you can convert your present PAYMOVER truck into a dual purpose machine that will serve as one of the basic tools you need for winter maintenance.

Estmag Models T-225SL and T-300SL PAYMOVER snow removal trucks can be turned into effective snow fighters in 15 minutes time, simply by adding the special snow fighter attachment. These units can travel at speeds up to 20 mph to help keep snow and loading areas open and avoid costly delays of disrupted flight schedules.

This blade is 20" high, has vertical hydraulic control and clears a 20' path over open and ramp areas in one sweep. It is specially designed to remain in snow load through a unique ramming action that keeps side spillage to a minimum and eliminates the need for additional passes. A special trapping mechanism prevents the loss of each side plane to follow ground contours. This allows working over uneven surfaces without reducing travel speed.

The complete line of PAYMOVER snow removal trucks includes units up to 35,000 lbs. drawbar class and smaller units (as low as 3,000 lbs. drawbar) for all types of snow, paving and other prime mover work at terminals. Call or write for complete information.

The new standard-duty T-225 PAYMOVER is built to pay for itself in one winter. It has a maximum drawbar weight of 35,000 lbs. and a speed of 20 mph. Effective ramming from steel blade. Safe for considerably less than any previous 4-wheel drive PAYMOVER.

HOUGH®

THE FRANK G. HOUGH CO.
1000 Hough Ave., Louisville, CO

Send data on snow fighter attachment
 Send data on complete PAYMOVER line

NAME _____
TITLE _____
COMPANY _____
ADDRESS _____
CITY _____ STATE _____ ZIP _____

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Two ways to get aerospace workstands and scaffolding:

1

First find someone locally who can recommend and design custom-made equipment that fits your needs. Someone with plenty of aerospace experience, who can really understand your problem. This may take a few weeks and cost plenty. Then find an outfit who can fabricate the scaffolding, or hire the people yourself and buy them all the equipment they'll need. This may take another few months, and it could cost a fortune. Then, after a few tries and some hacking and fiddling, you'll get some workstands or scaffolding you can depend on. Maybe.



Call us and you'll get exactly what's needed, *fast*—at lower *initial* cost. Send for a copy of our booklet showing a dozen typical aerospace jobs we've done lately, from simple access platforms to special subassemblies and roll-over ejection scaffolding, from aircraft workstands to aerospace rovers. Bulletin G246 is yours for the asking.

PSB
AEROSPACE
DIVISION
THE PATENT SCAFFOLDING CO., INC.
Box 2010 Denville, New Jersey 07834

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2

Call Patent Scaffolding's Aerospace Division.

THREE MORE FOR SPACE FROM DI/AN®
available now — from production

MILLIWATT CLOCK:

- Dual Memory, Real or Elapsed Time
- Digital or Analog Output
- 24" max event history record — 100,000 events
- 1000s of subevents or data sets
- Standard resolution: 15 to 8 seconds
- Accuracy: ±5 and ±0.05%
- Dual Memory and all data for monitoring and diagnostic logic
- -50°C to +100°C Operating
- Dual output by CMOS

MILLIWATT MEMORY:

- 24" max dual bus experience in real time event logic
- 1000s of subevents or data sets
- 1 to 3 milliwatt steady power
- All output as 16 bit logic
- All dual memory for monitoring and diagnostic logic
- -50°C to +100°C Operating
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- 24" max dual bus — each bus has 1000s of subevents
- 1000s of subevents or data sets
- 1 to 3 milliwatt steady power
- All dual memory for monitoring and diagnostic logic
- -50°C to +100°C Operating
- Dual output by CMOS

HISTORY In 1961, (prior to our first) comes closer to matching DI/AN's history of reliability in magnetic logic equipment for space. First, the operating history of these devices (and their predecessors) approaches a million hours in over 30 different aerospace programs with no known failure.

RELIABILITY This, mind you, is a record of actual use of our clocks, timers, counters, memory memories, etc. The record is broken by two life tests of our individual modules. Our Transistor-Transistor Logic (TTL) logic, with which these modules are made. The Tests have required 156 million module hours over 5 years — no failures, and 156 million module hours over 2 years — no failures. These numbers are for complete logic elements — but compare them with numbers for single components!

THE KEY TO THE HISTORY AND RELIABILITY The unique techniques inherent in CTL magnetic logic design: low power,

low capacitance, non-critical semiconductor parameters, no incremental bias plates, resistance to radiation and extreme temperatures. Plus, extraordinarily high, fully tested circuit integrity. Over 10,000 high logic power CTL's per cubic foot. Today's CTL's make a powerful GP computer.

SHORT DELIVERY One type of magnetic logic element is used for all functions — function determined by interconnection. New equipments are built with minimal no-electrolytic engineering time required. Product line units illustrated above are available on short delivery from current production.

WRITE FOR DATA SHEETS and special report on "MAGNETIC LOGIC IN SPACE — A REPORT ON HISTORY AND RELIABILITY".

ALSO AVAILABLE Literature covering three other DI/AN product areas • Magnetic Logic and Register Modules and cards • Standard Core Memories • Data Systems

Di/An Controls, Inc.

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Electro- and hydromechanical for missile, aircraft and ground support applications.



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VALVES

Many types—many applications for hydraulic, pneumatic, fuel and exotic fluids.



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PUMPS

Perfected—submersible—wide range of uses, speeds, pressures.

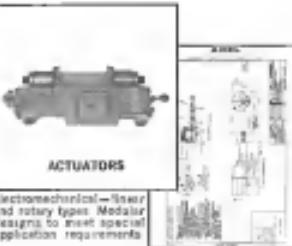
Dynamic—submersible and line inverted—AC, DC and other drives. ASK FOR DATA SHEETS



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GREAT LAKES MANUFACTURING CORP.
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ACTUATORS

Electromechanical—linear and rotary types. Modular designs to meet special application requirements.



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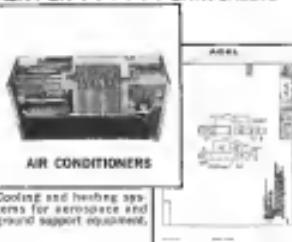


REFRIGERANT COMPRESSORS

Minimum weight and size, for airborne or ground check out electronic cooling/heating requirement. Multi-cylinder designs available.



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AIR CONDITIONERS

Cooling and heating systems for aerospace and ground support equipment.



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APEX Military Universal Joints are built to conform with and exceed all requirements stipulated in Specs. MIL-UR-202A, Class 2, Standard Drawing M6-28271 (Heavy Duty) and Class 1, Standard Drawing M6-22270 (Light Duty), as indicated in Qualified Products List QPL-1952. OFFICIAL TECHNICAL SUPPORT IS ALSO PROVIDED THROUGH THE APEX MANUFACTURERS TO ENSURE SPECIFICATION REQUIREMENTS.

APEX Military Universal Joints Offer:

BALANCED DESIGN

High axial and torsional strengths.
High strength-to-weight ratio per lb.
Maximum maintenance-free life.
No replacement during anticipated service life of airplane or most applications.
High mechanical efficiency, low wear.
Low torsional deflection.
Not adversely affected by Boeing or fret corrosion under shock loads or vibration, or by operating overloads.

NOMINAL SIZES: 3/8" THROUGH 1 1/8"

PERMANENT LUBRICATION

Working parts enclosed in covers especially adapted for service in heat, cold, dust, oil, etc.
SEALERS, LUBRICANT-RETAINING COVERS provide a supply of lubricant in excess of actual requirements, for long service periods.
Provide dust, vacuum, lubricating film in bearings.
Provide high resistance to vibration, offer vibration damping.
Reduce heat dissipation; eliminate corrosion.

WRITE FOR CATALOG 38

UNIVERSAL JOINTS and ASSEMBLIES

Filament Winding...

Capability Unlimited

What do these have in common?

They are all products of the world's leading filament winding facility. A pre-programmed hydraulic servo mechanism is the basis of the B&B developed filament winding machines which normalize exacting tolerances and assure repeatability and reliability. Assembly areas are dust free. Temperatures and humidity are rigidly controlled. Extreme versatility eliminates size limitations previously imposed on filament-wound structures.

B&B filament winding production facilities include 120,000 square feet of security controlled manufacturing area. Additional space with unheated primary utilities is available for continued expansion. The plant is completely accessible by air, rail and interstate motor freight.

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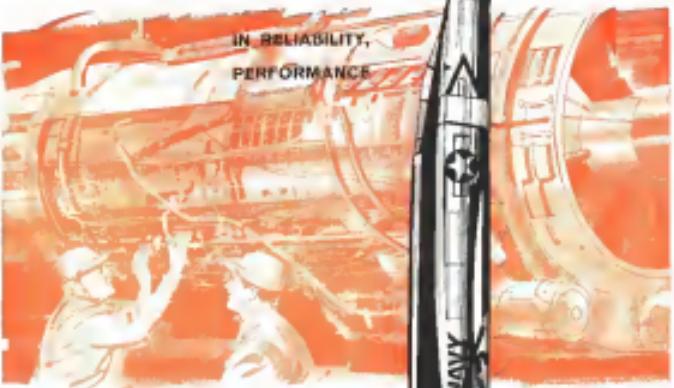
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TYPE 1307 FUEL CONTROL IS

HIGH

IN RELIABILITY,
PERFORMANCE



YET—
LOW IN WEIGHT
AND COST

An aircraft speeds
rings into the
supersonic and
beyond Mach 2,
engines control
needs become
more and more
critical and
exact.
Meeting The J-7B
engines on the record-setting F4H aircraft
have Woodward controls which quickly and
accurately sense and act upon the slightest
angular variation.

Type 1307 Fuel Control on the F4H is a
striking example of the capability of a compact
precision control to meter fuel precisely
under swiftly changing conditions. Write to
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Circle Number 17 on Reader-Service Card

HARRISON'S CHRONOMETER *Marine Chronometer*
No. 1, invented 1755 for determining longitude
functioned within an error of three seconds per day.
This is one of a series commissioned by the
Canadian Marconi Company. A printed reproduction
of this historic navigating instrument, size 11 x 14 inches
is readily available on request.



228 years before DOPPLER

Between the chronometer and Doppler lie 228 years of man's attempt to mark an accurate track of his coming and going over the earth, and of his immediate position on its surface. Canadian Marconi Doppler provides a new measure to the navigator's art possessed by the astrologer for latitude, compass for directions, sextant for position and chronometer for time. With the compass, CMG Doppler gives the art all these simultaneously, without human error. In the most accurate and reliable system used today CMG designs and manufactures Doppler for "G" and "J" bands, Lat/Long and Along and Cross Track Computers, as well as indicators. CMG Doppler is applied to commercial transport, aerial survey, military transport, anti-submarine warfare, helicopters, V/STOL aircraft and supersonic aircraft.



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Doppler Computer Products



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"You get ACTION at brooks & perkins"

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What you can do with General Electric's versatile RTV silicone compounds
to insulate, seal and mold from -150°F to 500°F



Encapsulate it. Fluid RTV silicone rubber penetrates deep into transformer coils. RTV has excellent dielectric strength and provides cold resistance.



Fill it. Transparent or opaque, GE silicones provide a excellent protection against moisture, stains, thermal and mechanical shock. Fuses freely around insulated parts, can be cut away to replace insulation components.



Resist it. Flexible RTV is often used to make molds for photocopies and sheet metal resistors. This part requires deep undercutting, but duplicate parts can be easily made. RTV's tensile strength is as high as 850 psi.



Seal it. Bondable RTV silicone rubber is particularly suited for end-applied surfaces and relies less on metal and chemicals. Can be used for sheet metal fasteners, sheet insulation, sealants, sealants and Vincennes range from possible to joints.



Bind it. Aftercuringbond RTV-102 requires no mixing of catalyst, can be used in standard open setting, for an instant bonding, gluing and sealing. RTVs are virtually ageless, will not stress crack or weather.



Microseal it. RTV silicone/siloxane are fast curing, extremely soft, silicone preformed parts to user ready, time consuming techniques. Here an RTV silicone insulates flexible metal strips to form cylindrical seals.

If you would like a free sample of one of the nine General Electric RTV silicones for evaluation, write us your letterhead, describing your application. For additional information, check reader service card. Section 2100, Silicones Products Dept., General Electric Company, Waterford, New York.

GENERAL **GE** **ELECTRIC**

Circle Number 11 on Reader-Service Card



How to squeeze more horsepower into every inch of engine displacement



...another example of Caterpillar capabilities at work

When Caterpillar Research Engineers talk about this project, they call it VHD.

Officially, it's a research project to design a family of four Very High Output engines for the U. S. Army Tank Automotive Command. The family will deliver more working horsepower per inch of displacement than any compression-ignition engine now available. Horsepower-to-weight ratios will be in the per-turbine range.

Current design indicates a realistic initial target of 80 HP from each cylinder at 2600 RPM. This is without revolutionizing engine structure or creating highly sophisticated aspiration methods.

Even in the design stage, trenchlessness is certain. Of the 294 major parts needed for the entire family, only 36 parts have single usage, and 164 are used in at least two models.

Because of this high interchangeability, vehicle designers won't be hampered by a single engine configura-

tion. They will be able to arm the external accessories on these 4.5 x 5.5 bore and stroke engines to suit the vehicle ... without adding parts to the logistics system.

The VHD research program demonstrates another of Caterpillar's capabilities in the area of military vehicles and engines to power them.

If anyone knows how to squeeze a thundering head of horsepower into a military compression ignition engine—or create a highly specialized piece of ground support equipment—Caterpillar does. To find out just how far Caterpillar's abilities range, contact Defense Products Department, Peoria, Illinois.

CATERPILLAR

Patent to and held by Caterpillar Tractor Company for its use.

Caterpillar Tractor Co., General Offices, Peoria, Ill.; Caterpillar America Co., Peoria, Ill.; Caterpillar Tractor Co., U. S. Branch, Specialized Assembly, Ill.; Mechanical Components Division, Peoria, Ill.; Caterpillar Tractor Co., U. S. Branch, Components Division, Peoria, Ill.; Tractor Components France S. A., Bures-sur-Yvette, Seine-et-Oise, France (through CFC S. A.); Caterpillar (France) S. A., Bures-sur-Yvette, Seine-et-Oise, France.



WHEN FILTRATION IS REALLY CRITICAL (And the spec is 8815)...

THE ANSWER IS SCREEN PRODUCTS SP-2105 HYDRAULIC FILTERS

Sometimes a filter element doesn't get changed when it should, and it has to do when dirty oil bypasses the filter and circulates through the hydraulic system.

But some applications are critical...especially in the aerospace field.

If you've been working to the MIL-F-8115 spec, you've had little choice, until now. Now there's Screen Products' PreSeries 2105. The 2105 series features a 141PM3 ME-9174 thermal filter. A longer life means economical. In time, dollars and performance. Thus cleaning a dirty element, THERMO-MESH provides absolute filtration down to 15 microns, with greater dirt-holding capacity and higher working temperature than other wire mesh filters with the same efficiency rating. And they SP-2105 is available without



bypass. The rugged filter element is designed to withstand full rated pressure (4500 psi) without collapse.

Further, SP-2105 features for critical applications are: a bypass Products' PRESSURE GLOBE™ oil filter bypass valve which releases a dirty filter element through a visual signal when differential pressure buildup reaches a predetermined level.

A variety of sizes, styles, and seals are available in the new SP-2105 series, and many sizes use the same THERMO-MESH element, reducing replacement costs.

If you're dealing with really critical filtration problems, you'd better know more about the SP-2105 series. Ask for Technical Bulletin PA-300.

*Patent pending.



SCREEN PRODUCTS DIVISION - CONTINENTAL COPPER & STEEL INDUSTRIES, INC.
P. O. Box 433 - Caldwell, New Jersey 07006



Next Coast Representation by: Permanent Filter Corporation - A subsidiary of CCS, Cypress, California

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Drawing of Titan III-C Standard Space Launch Vehicle



Seven foot diameter nozzle

CAMERON PRODUCES WORLD'S LARGEST CLOSED-DIE FORGING FOR TITAN III-C STANDARD SPACE LAUNCH VEHICLE

Forged for Thompson Ramo Wooldridge, Inc. to meet design specifications of United Technology Center. These **SEVEN FOOT** diameter nozzles are forged with one heat and one stroke on Cameron's 20,000 ton closed-die forging press.

Cameron produces forgings of unmatched quality and configuration by using the most advanced techniques available in the forging industry. Cameron's completely integrated facilities include heat treating, vacuum degassing, vacuum arc welding, forging, heat treating, and rough machining, giving customers the benefit of an undivided responsibility for quality and delivery. You too may have a requirement for a "ONE RESPONSIBILITY" forging. Call, write or come by.



20,000 Ton Forging Press

Cameron

CAMERON IRON WORKS, INC. SPECIAL PRODUCTS DIVISION
P.O. BOX 1312 HOUSTON, TEXAS

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Q: Why do more government agencies come to MPO for their films than anywhere else?
A: Simple. MPO has a staff of production and camera crews that already have security clearance. MPO has the experience that makes the film crew part of the project team. MPO has the world's most modern motion picture studio center. MPO is ready to shoot anywhere in the world. MPO makes films for the U.S. Army, Navy, Air Force, NASA, FAA, Bell Labs, Ford, GM, Eastman Kodak, U.S.S. and many others. Want an estimate? Want to talk about films? Want a brochure describing our new studios? Write or call Andy Gold. He's in charge.



Special Projects Division, MPO Productions, Inc./222 E. 44 St., N.Y. 10017, Attn: code (312) TH 7-6208/also in Detroit, Chicago and Hollywood

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INLAND D-C Torque Motors

Inland provides a complete line of compact d-c torque motors for direct drive servo positioning. High-torque output, low-power input and high angular resolution are offered in discarce, space-saving pinion-style.

Exclusive commutator and brush rigging design.
Complete range from 0.1 to 3,000 pound-feet.
No gear backlash or gear train problems.

Inland Amplifiers, relay and solid-state, are available for systems use with Inland torque. The 100-watt solid-state d-c amplifier, shown here, is the first of its type packing high power output in a hermetically sealed case only $2\frac{1}{2}$ " x $3\frac{1}{4}$ " x $2\frac{1}{2}$ ".



For complete data write Inland.
Dept. 9-4.

INLAND MOTOR

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CORPORATION OF VIRGINIA
A SUBSIDIARY OF
POLYMYRTH CORP.
NORTHAMPTON, MASS.



ON THE JOB WITH A GM HARRISON RESEARCH ENGINEER

Six months' work may be building on the results of the dial. The machine—a mass spectrometer—detects and measures air-conveyed small leaks by helium emission. The man—a GM Harrison research engineer—charts the source of new heat exchanger design.

UNCOVERING THE UNKNOWNNS IN TEMPERATURE CONTROL!

But Jim Harrison, there's plenty of room for his curiosity to expand. But he's a practical engineer, too. His "way-out" explanations air blow-to-earth evaluations. He proves his ideas in practice as well as on paper, in costs as well as theory. His research emphasis is on the development of ideas to improve the efficiency and reliability of Riley's temperature control equipment as well as大家's.

In addition to product development and improvement, he and his associates are always a rich source of technical information and assistance in the fields of marine, industrial, nuclear, automotive and aerospace heat transfer. Good reason to look to GM Harrison for your next temperature control solution.

Free

For an informative 16-page
booklet on the complete Riley
line... write to Department 903.



AEROSPACE, AUTOMOTIVE, MARINE AND INDUSTRIAL HEAT EXCHANGERS

HARRISON RADIATOR DIVISION GENERAL MOTORS CORPORATION LOCKPORT, NEW YORK

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CHATHAM TRANSFORMER-RECTIFIERS THAN
WITH ANY OTHER POWER SUPPLY



BRUNSWICK TRANSFORMER-RECTIFIER SERIES T-8



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Researched, developed, manufactured
and tested... in house by Brunswick



ROCKET MOTOR CASE—Brunswick is a leading designer and manufacturer of through-bore wound motor cases. Experience in Peenix, Alum and other programs has created a broad base of knowledge for design, fabrication, and test. From the fabrication of the insulation to the final hydrodynamic testing of the completed case, Brunswick can offer a product of unsurpassed reliability.



RADOMS—for supersonic aircraft and missiles. Brunswick's broad line of radomes provides guaranteed transmission properties by precise metal control, matched to the required frequency. With a maximum inflation of $\pm 10\%$, Brunswick's electron-beam facilities include ten test ranges for polarity studies on all types of antennas with dielectric properties characteristics.



HONEYCOMB ASSEMBLIES—Brunswick has complete facilities for the design and fabrication of aluminum sandwich and reinforced plastic composites. Large possible panel sizes are fabricated in ± 0.03 contour tolerance. Other sandwich assemblies can be fabricated using a wide variety of adhesives and materials. Brunswick's decade of experience has made it an acknowledged leader in this field.



INTEGRATED ANTENNA—Brunswick notable integrates all communications, telemetry and navigation antenna and reflectors within primary structures. No bending or removing interferences. All planar arrays and satellite antennas have high weight-to-gain ratio, while providing aerodynamically clean lines. Can Brunswick Corporation help you in any way? Write or call today!



MAKING YOUR IDEAS FLY
Brunswick
Electronics Corporation • Defense Products Division
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Sinclair keeps ahead – to keep aviation ahead

Keeping up with aviation's progress is a pretty hard job these days. Keeping ahead is even harder but Sinclair Research takes pride in doing it.

power—Bendix jet fuels which jets used to break the sound barrier—special Sinclair lubricants which helped to put men into space.

From this research-for-progress have come many products of great help to aviation—Simpler higher-octane fuels which give piston engines greater

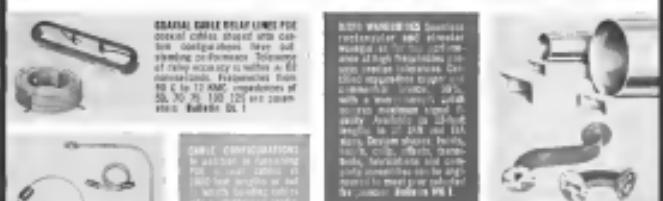
Sinclair Turbo-S Oils are among these fine products. Major airlines rely on Turbo-S Oils by Sinclair, a leading supplier of quality aviation products.



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PDE
SYSTEMS
COMMUNICATIONS
COMPONENTS
AND
CAPABILITY



standard 100' cable with a 10' lead-in to the optional 10' cable. The optional 10' cable is an extension of the primary 100' cable. It is terminated with a standard 10' male connector and a standard 10' female connector. The optional 10' cable is terminated with a standard 10' male connector and a standard 10' female connector. Refer to Figure 2-1.

ADDRESSABLES: *Proton + p-0.61, values including eggs plus dead fungi and fruits are probably underestimated in POC conversion factors 401-402.*

SYSTEMS CAPABILITY Throughout the microwave spectrum, PDE subsystems and systems are operating with an unusually high degree of reliability. Missile guidance and guidance, radar, telemetry, a dozen of diverse applications have demonstrated PDE capability and proven PDE potential everywhere.

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Class Number: 30 as Reader: Recent Events



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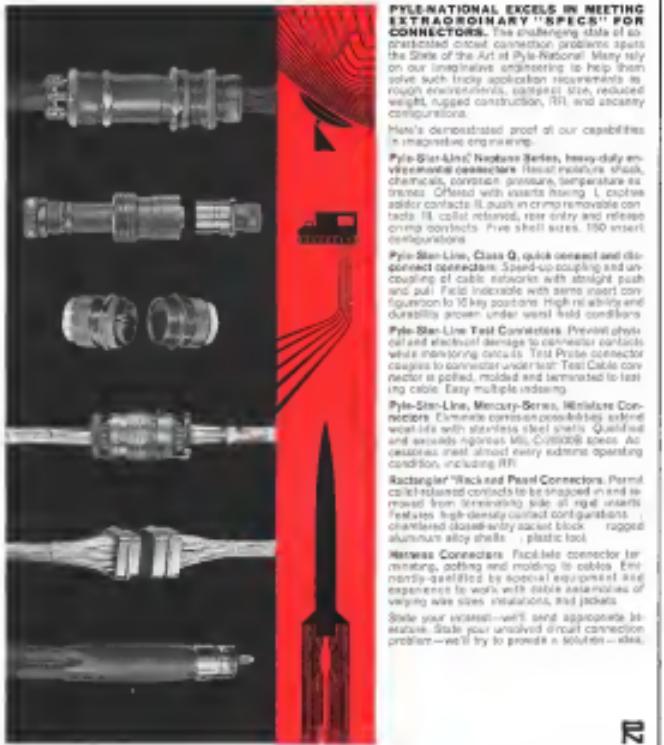
There's no room for failure on aerospace flights . . . that's why PESCO's piston pumps are built to run at high speeds for long hours at extreme temperatures. PESCO's spherical pistons, with fine contact rings, maintain zero bore clearance for the life of the pump . . . keep efficiencies high at fluid temperatures from -45° to 300° F . . . make pumps relatively insensitive to contaminated fluids. No PESCO pump has ever failed during more than 25,000 hours of operation on aircraft and missiles. For your piston pump requirements, using either fuel or hydraulic oil, look first to PESCO.

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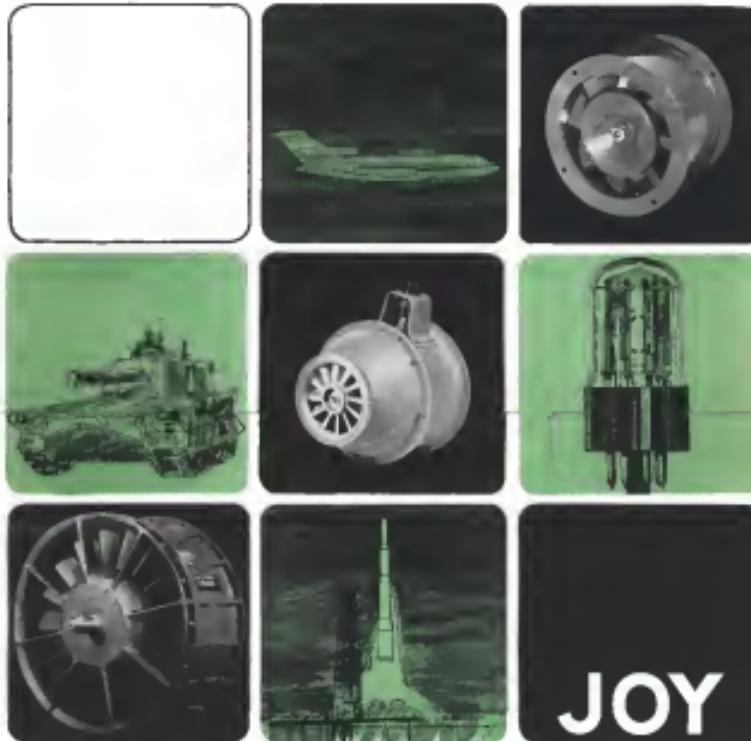
"Thiokol" - an rocketry, gelled propellant that flow like liquids when pumped or pressurized. Why thiokol propellants? Improved safety, design simplicity, but most important, increased rocket engine performance. Gelling is one practical way to suspend high energy metallic particles in moderately energetic liquid propellants, particles which substantially boost propellant bulk density and specific impulse for many current and planned applications.

Thiokol's Reaction Motors Division is spearheading present and future phases of thiokol's engine technology. Under Air Force and other hardware-oriented programs, key rocket system components are being designed fast, and evaluated with gelled propellants containing metal addi-

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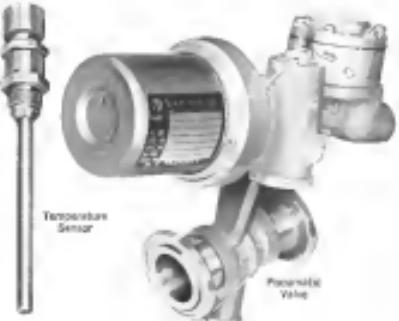
VAP-AIR PNEUMATIC TEMPERATURE CONTROL SYSTEM

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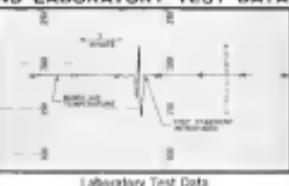
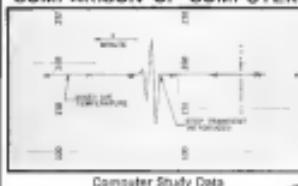
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Message From the Publisher

Industry's Endless Challenge

The aerospace industry is facing another year of technical and economic transition that will offer a substantial challenge to management. It has been a tradition of the aerospace industry, from the original Wright brother factory in Dayton to the space age, that technology has forced changes almost faster than anyone can follow. Both industrial and political have been able to absorb them. The penalties for those who have failed to perceive these changes have been severe. The rewards for those who have ridden the crest of expanding technology have been substantial.

The Buyer's Guide this year should provide the aerospace industry with some significant clues on what changes in procurement and technology, forecast for 1964 and beyond. The Fiscal 1963 budget for the Defense Dept. and the National Aeronautics and Space Administration are now being hammered into their final form for presentation to the Congress next month. It is already clear that they will continue an extremely high level of activity across the entire spectrum of the aerospace technology. The goals of the major ICBM programs such as Titan, Minuteman and Polaris, plus, clarify the acquisition of costly land based and mobile-powered submarines, have passed. But there will continue to be strong activity in developing improved propulsion, guidance, sensor, vehicles and command systems for advanced models of new ballistic missiles that can be accommodated in the test capsules of concrete silos and submarines already established. The biggest military procurement item will continue to be aircraft and their related equipment. It is significant that even when missile spending reached its peak in the year just past, it never equaled the steady level of aircraft procurement, and never even came close to splitting the market evenly as so many false prophets predicted.

Resurgence of Aircraft

The aircraft portion of the aerospace industry is headed for a period of lively technical development stimulated by accumulated technical neglect during the past several years and the development of a wide range of new military requirements for flying vehicles of all types. Those who shunned aviation prematurely as the first flush of manufacturing are now due for an agonizing reappaisal.

Space technology will continue to expand in both its NASA and military phases, with additional impact from the growing international realization that no nation can play a significant role in the world tomorrow without a sound capability of its own in the science and industry of space.

The greatly expanded Products and Services section of the Buyer's Guide this year lists more than 4,000

manufacturers in this country, Canada and Europe, and even some 2,000 specific types of products they make. Here are the clues to the new materials, production techniques and sources of supply to meet the new technical challenges of the 1960s in aerospace.

Performance of the difficult task of keeping track of the significant facets of a changing industry, and tailoring its size and scope in detail, has been substantially improved for this Buyer's Guide now by the use of modern data reduction techniques that will assure its already wide readership acceptance as a basic management tool. The acceptance of the Buyer's Guide as a long-term management aid was documented by a study conducted on the previous edition six months after its publication. A total of 66% of the respondents in this survey still retained their copy and 53% still referred to it at least once a month.

Service to Readers

The Buyer's Guide is an essential ingredient in the year-round editorial service that AVIATION WEEK & SPACE TECHNOLOGY provides its engineering-management readership in the aerospace industry. In forecasting significant technical and economic trends, spotting their initial emergence into hard policy, and interpreting their long-range effects. In addition to the regular weekly news, special editions are devoted to major forecasts across the entire technical spectrum in the "Inventory of Aerospace Power" each spring; a special report in depth on the most important phase of research and development is mid-year, and the series of international air transport in the fall.

In addition to its problems with changing technology, management in the aerospace industry will find next year a crucial test of whether the new-type contract will still provide significant rewards for better cost performance and tighter program management. As the procurement picture is now planned, industry profit should improve where performance meets. But, as with so many government policies, the difference between promise and delivery is often substantial. The scope and character of these potential rewards should become apparent to industry next year in the application of the new-type contract spreads.

Next year will be the sixty-first year of the aircraft, the twentieth year of the liquid-fueled ballistic missile and the seventeenth year of the space age. The challenge to aerospace management is to handle the continuation of technical forward, political problems and economic justs that will be generated by these three facets of a common technology will never be greater.

—Robert W. Martin, Jr.
Publisher

DOD Maps Contract Management Changes

By William H. Gregory

Washington—Defense Dept.'s extensive modification of military procurement policies and procedures was completed for the most part this year, and next year will be one of consolidation and refinement.

Industry's day to day operations, however, may be strongly influenced by what will probably be DOD's only major new item on the 1984 procurement agenda. That is a field evaluation in the Philadelphia area of combining the contract management functions of the services, under study in DOD's Project 60.

Involved here are reporting requirements, required by contractors in a chronic headache. Industry finds reporting requirements are generally excessive, but for contractors with multiple government contracts—with the military and with the National Aeronautics and Space Administration—they can be faced with as many as five different types of reporting formats, each with essentially the same information, giving birth to many data.

Contract management, which covers diverse phases of primarily post award actions with contractors that include quality surveys, quality assurance, production, consulting, plant expansion, plant transfers, and so on, has been the last frontier with little procedural guidance at the beginning of DOD.

Looking to the future, the services followed their own evolution in developing systems that DOD feels are not necessarily weak, but do increase government and contractor overhead, he claims of the deficiencies.

Organizations and procedures for the pilot plan are being recommended by the management consulting firm of Booz, Allen and Hamilton in a subcommittee to the Logistics and Management Board, as well as other boards in DOD.

The sub, and Project 60, are under

consideration, recommended establishment of the directorate.

Plan for the test program call for it to begin in February, continuing for three months, and lead to coming under the Armed Services Procurement Rules by early July 1. The test system may be a combination of the major procurement arms of the services—or at least, being about elimination of the less effective ones.

DOD and the services are proceeding cautiously to the program because of the possible impact on local contractors through personnel transfers and changes in installations. Almost 43,000 people in 44 field organizations are involved in contract administration and reporting services. Another reason is that Project 60 has stirred fears in the field that the initial government structure of the services will be reorganized.

Top defense officials do not find

any need to move consolidation of such a bureau as contemplated other than to coincide now with the Defense Supply Agency.

Increased emphasis on incentive con-

tracting and the reduction of cost plus

fixed fee contracts—will undergo over the past year—a considerable defense shift to the most aggressive phase of the current DOD procurement program.

But there are three other important elements, two of which become policy relatively late this year and which will not be fully felt by industry until 1984:

• Program definition phase in a contract, prior to award, to include

• Weighted guidance system

• Use of the services for setting target prices in all contracts that expect cost analysis,

• Advanced weapons system development

• Increased weapons system development

</div

DSA Aerospace Procurement May Grow

Cameron Station, Va.—Aerospace in defense contractors may find the Defense Supply Agency becoming a larger factor in the business environment as a result of a study of acquisition management at aircraft turbine and jet engine suppliers, and aircraft firms.

Following a pilot study of the overall \$10.12 billion, 710,000 item military aerospace catalog inventory in 1982, a more detailed evaluation began early in 1983 of 33 federal supply classes covering 170,000 items with a \$5-billion value, all but the top five categories relating to aircraft engines.

The study, by an Army-NASA team, was headed by USAF Col. Robert L. Thornton of the Defense Supply Agency and was in the acquisition stage, following work by USAF, Air Materiel Area units, Air Force Logistics Command, the Army's Aviation Center at Ft. Rucker, Ala., and the Navy's Aviation Supply Office in Philadelphia.

The report is due to go to Defense Secretary Robert McNamara at the end of January. It will then be submitted to the services and to the Defense Supply Council, marking a decision study before spring.

No other firm has a study under way for acquisition management, but aircraft contractors are doing an increasing amount of business through the Defense Supply Agency's Defense Electronics Supply Center at Dayton. The center and APTI will take over the last clusters of an 800,000 item military electronic inventory.

Procurement this past by the Electronics Center—covering such products as mission, navigation, transceivers, tubes, switches, connectors, relays, antennas, waveguides, connectors, feeders, and feedthroughs—totaled about 20% in an estimated \$4.37 billion.

In fiscal 1983, procurement at the Electronics Center was 15% para competitive, much of it formerly off-contract, and that figure rose to 33.8% for the first four months of fiscal 1984.

Procurement is continually under way at the center, though acquisition begin and often consolidated into packages that can be supplied by engineers with multiple vendor teams.

The Defense Electronics Center has a more limited role in the three basic categories of military hardware:

- **Code A** items are those of unusual lead design or of critical critical nature, or peculiar to a particular weapon system. These the services buy them selves.

- **Code B** items are repetitively produced stock items, what would amount to catalog items. These fall into the

Defense Supply Agency category

- **Code C** items are catalog items, available in small quantities, and used only for aerospace industry.

• **Industrial** items are equipment managed by the Defense Industrial Plant Equipment Center at MacDill Air Force Base, which was activated this year. Though it has no procurement mission, the center screens all contractor tooling plans to ensure that excess or obsolescent government inventory is not stored in government inventory at an storage sites that can still be accessed by a small defense new tooling is purchased.

The center then handles disposal of no longer government machine tools.

- **Industrial and construction supplies** Not generally considered aerospace equipment, these do play a role in procurement. Of the 95,000 items, there for the Potomac Plant Baltimore, Md., System Command, including the following subcategory, Defense Supply manages 17,000; of McDonnell's 14,000 stock items, Defense Supply handles 4,000; more for the site portion of the USAF and supplier's subcontractors. Both the mobile Army's Hawk anti-aircraft missile has 18,000 stock items and Defense Supply manages 5,500.

- **Flight requirements** for military aircraft are handled by the Defense Personnel Supply Center.
- Defense aircraft procurement is mainly aircraft made in the Centaur Systems Division, published by the Department of Defense. Contracts can be placed on lot for in-service of parts by writing Defense Supply Centers and filling out request forms. For contractors, purchase surveys are made prior to contract award, but are not required for bid invitation.

The following list provides addresses of Defense Supply Centers at possible interest to aerospace companies:

Washington

Defense Supply Agency

NASA Plans More Competition, Incentives

By Alfred P. Albrechts

Buying and contracting practices of the National Aeronautics and Space Administration are changing markedly, with increased emphasis on open bidder search and wider use of incentive the major outward signs of the change.

"We feel we had very good results from our five incentive contracts, which we negotiated this year," said George J. Vecchietti, Jr., deputy director of procurement. "We plan to use more incentive contracting on a selective basis, selective because incentives are difficult to apply in research and development."

NASA procurement regulations require that procurement plans for one procurement item be open to all contractors. All noncompetition contracts for over \$1 million must be awarded by the agency's top management.

In the last half of 1962, 53% of NASA procurement was on a competitive basis. During the first half of 1963, this ratio increased to about 55%. But NASA is still satisfied and may work to increase competitive contracting in requiring that no noncompetition awards be made without approval of center directors in NASA headquarters top management.

There has been some pressure from industry for NASA to allow selection of contractors on a sole-source basis. Distrust of weighted guidance scale has led to profit. Under such a system, various aspects of work under a contract, such as engineering and production, are "straight."

Although NASA has not made a decision on the weighted guidance type of contract, it is the feeling of some in the agency's top management that this kind of contract is not suitable in a research and development oriented effort.

Agency officials advised they will continue to contract for industrial service, research and scientific talent. There

has been witness by Congress, the Budget Bureau, and the congressional general of NASA's severe cost cuts. The Defense and General Electric Apollo service contracts have under special review in Congress but not yet.

Despite the criticism, NASA maintains that it is more practical and cheaper in the long run to award contracts by contracting for outside services. Rather than abandon the buying of sole-source services, NASA will try to write contracts for these services in such a way that it can meet with the approval of congressional procurement agents.

NASA also plans to expand its cost estimating procedures because in almost every major program, the agency has underestimated costs by as much as 100% or more.

"We now have five teams of engineers to do this," said Vecchietti. "NASA also will make a study of the methods used by industrial firms which historically have been the most accurate in estimating research and development costs."

Cost Reduction Progress

Cost reduction processes also are under study, and NASA is looking at both its own laboratory operations and those of its contractors in areas where cuts might be cut. From these early studies come recommendations on specific industries and NASA laboratories where cost reduction programs look most promising.

Still another tool NASA will use to expand its procurement methods is the Defense Dept. contractor performance evaluation. NASA has developed and is using it well now, but it is likely that the agency will use it as soon as possible in aerospace firms already available in the Defense Dept. data bank in performing the evaluation.

NASA's higher procurement priorities stem from both the agency's in existing contracts—it was four years old last Oct. 1—and the fact that objectives expressed last year in Congress for the Apollo manned lunar landing program. Although NASA Administrator James E. Webb reported that the \$5.77 billion requested for Fiscal 1964 apportioned only \$1.5 billion to Congress, est. that in \$5.57 billion is the authorized amount and actually appropriated only \$5.1 billion.

NASA was forced to slow down the Apollo program because of the cut in Fiscal 1964 funding, and there is a growing fear within the agency that inadequate appropriations may the next



First Production S-4B Tank

CYLINDRICAL SECTION OF LIQUID HYDROGEN part of the first Douglas S-4B Saturn stage ready to go in a part of the tank for welding of an angle ring on one end, to which a skirt will be bolted. This tank will be tested to destruction in a hydrotesting tower. Both final assembly and testing of the S-4B up to the instrument fairing stage will be done at the new Douglas Space Systems Center at Huntington Beach, Calif. New recommendations/assembly building has 370,000 sq ft. Workers guide rating limit frame to which the angle is attached. Welder head is at the top of the welding tower at 26 ft.

In Contracts

time when the budget in the named four-line budget program could be at a peak—or further cutbacks the program.

President Johnson will ask about \$1.7 billion for NASA in Fiscal 1965. But Congress took the cut in the 1964 NASA budget, the agency will come out with no more than \$5 billion.

Policy Changes

Policy shifts in procurement are aimed at dispersing charges of waste and duplication in the space program and in spreading the work geographically as well as in time. Through the bulk of NASA prime contracts is still a very concentrated area in East and West Coast. With a recent study which shows that in 1963 NASA will have spent 95% of its funds or more than \$4 billion, through prime contracts with 3,980 firms in 49 states and the District of Columbia.

The Fiscal 1963 procurement report is in preparation, will show little change from Fiscal 1962 in the 10 states showing the largest dollar share as NASA prime contracts. California, the leader, received more than \$1 billion. Next in order are Missouri, Louisiana, New York, Alabama, Florida, New Jersey, Texas and Maryland.

In Fiscal 1963, 18 of the 100 largest contracts let by the agency were received by small business. And small business received about \$90 million in contracts, or 2.2%.

These are small business awards as compared to NASA headquarters and at such rates when major proposed purchases of contracts over \$5,000 to determine which and how small firms can participate in the procurement. Small business during the acquisition NASA with their capabilities as spinoff learning of subcontracting opportunities should contact the small business advisor at headquarters.

Following is a summary of activities resolved at the agency's headquarters and research centers.

Headquarters

The division is responsible for headquarter procurement and acquisition, including multiple studies, management studies, the initial phases of research and development projects, feasibility studies, legal, logistics, purchases and office equipment and supplier needed for support of headquarters activities.

Research grants and contracts with



Centaur Stage Mated to Booster

GENERAL DYNAMICS/AEROSPATIALES CENTAUR liquid oxygen upper stage is mated to the McDonnell Douglas F-104 Starfighter at the McDonnell Douglas Space Center at Cape Canaveral. (AF Photo) On Nov. 27, McDonnell Douglas space management was assigned in NASA's B-7-301 flight test and 51st mission. The first flight demonstration of liquid hydrogen as a launch vehicle fuel. Centaur's two Pratt & Whitney RL10-C3 engines each rated at 31,000 lb., are shown below as the stage was lifted into place. Ground test programs which led to successful flight will continue through assembly of test article and development Centaur vehicles. Next flight test vehicle is tentatively scheduled in fly only next year.



nonprofit and scientific and educational institutions) are the responsibility of the Office of Grants and Research Contracts at Headquarters.

Ames Center

Ames has project responsibility for the Pioneer spacecraft and the Biosatellite Program. Unmanned probe designs and the use of computers and computers will minimize the effect of the non-synchronous on earth operations, including missions. NASA's life science laboratory also is located at Ames.

Research activities at the center include ultraviolet and short wavelength astronomical research, basic studies in planetary entry and environmental plasma, guidance and control systems, aerodynamics, geophysical and behavioral sciences, and human factors.

Flight Center

Most of the center's research connected with flight is in the areas of aircraft and space from low speeds to hypersonic velocities. Programs in which the center is participating include the X-15, aerospace transport and sounding rocket development. Ground-based and flight research includes work on aircraft and structures, aerodynamics, thermodynamics and ballistics.

Goddard Center

Goddard Space Flight Center has the lead responsibility of any

NASDA installation. Its projects include most of the scientific satellite and agency responsibility for communications and weather satellite programs. Goddard also directs the operation of NASA's worldwide managed flight, material, and satellite tracking, communications and computing system networks and maintains launch teams at both the Pacific and Atlantic Missile Range.

JPL

Government-owned, Jet Propulsion Laboratory is operated for NASA by the California Institute of Technology. Most of the laboratory's work is confined to the Ranger and Surveyor unmanned lunar flight programs. The Mariner planetary mission is managed by JPL.

JPL also manages the deep space tracking network.

Longley Center

Langley Research Center conducts scientific and technical investigations on a broad scale in the areas of vehicle configurations, materials and structures, reentry, application of new materials, supersonic and hypersonic flight mechanics, reliable and reusable

unmanned space stations and development and improvement of inflatable guidance and navigation satellites.

Langley also has project management responsibility for the M1 liquid hydrogen engine, Centaur launch vehicle and Agena stage procurement.

Manned Spacecraft

Planning and carrying out manned space flight programs, from the start point of the manned vehicle, is the primary mission of the Manned Spacecraft Center. These missions include the successful Mercury program, which was concluded with USAF Major Gordon Cooper's M-9 flight last May 16 and the current Gemini and Apollo programs. The center also studies future projects, such as manned space stations and planetary missions.

Spacecraft design, new training, space medicine and other equipment also are responsibilities of this center.

Marshall Center

Development of large boosters is the primary responsibility of the Marshall Space Flight Center. Current programs include development of the Saturn 1, Saturn 1B and Saturn 5 launch vehicles. Marshall also is defining requirements for larger non-crewed rockets for future planetary missions. These studies include combinations of large liquid and solid stages, nuclear and other high specific impulse upper stages.

Nuclear Office

Space Nuclear Propulsion Office is a joint NASA-Aeronautical Corps, non-facilities, concerned primarily with the development of nuclear rocket engines for advanced launch vehicles. To accomplish the objective, the office is directing a program of research on reactors, engine systems, development of

Kennedy Space Center

Recently renamed for the late President, the center has facilities at the Atlantic Missile Range and Merritt Island that include buildings and equipment under construction for integration, test and checkout of the Apollo spacecraft. NASA operates or directs facilities at the Air Force portion of the Atlantic Missile Range for preparation, test and launch of the Gemini orbital spacecraft and related scientific and practical projects.

Lewis Center

Primary mission of Lewis Research Center is research and development of advanced propulsion and space power generation. This includes high-energy chemical, nuclear and electric rocket engines and space power systems for converting chemical, nuclear and solar energy into electricity. Lewis also has project management responsibility for the M1 liquid hydrogen engine, Centaur launch vehicle and Agena stage procurement.

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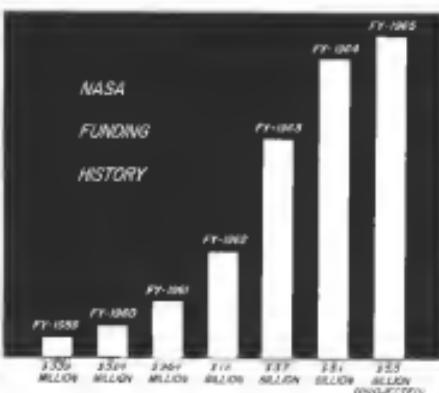
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NASA PROCUREMENT OFFICES

National Aeronautics and Space Administration, Washington, 25, D. C.

Conrad W. Bracken, D-3-8544
Director, Procurement and Supply

Joseph M. Rizzo, 382-8337
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Telephone: 481-7800
Executive Officer: Space Nuclear Propulsion
Office, Office of Research and Development
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Wallops Station
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Executive Officer: Wallops Island, Virginia
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Deputy Executive Officer: Wallops Island, Virginia
Telephone: 434-2211

WESTERN OPERATIONS OFFICE
258 Rice Blvd., Santa Monica, California
Telephone: 852-9641
Executive Officer: Santa Monica
Telephone: 852-9641
Deputy Executive Officer: Santa Monica
Telephone: 852-9641
Alexander Meissner

last, exhaust, high pressure, engines and stages, and acquisition of unanticipated space stations or launch vehicles for flight test, all parts of the Rover project.

Wallops Station

Wallops Station has been conducting rocket flights since 1945 in atmospheric and space research programs. Most launches from Wallops are sounding rocket flights using vehicles with a range of 100 miles.

Long-range flights launched from Wallops are the Scout and Thor-Delta rockets, which is used for high altitude reentry tests and uncrewed orbital satellite flights. A second Scout launch pad is nearing completion.

Northeastern Office

Mission of the Northeastern Office is to provide liaison with industry, and scientific and educational institutions at the northeastern states. The office, located in Cambridge, Mass., also manages contracts, advertising and public NASA contracts and grants within the region and conducts special government services.

Western Office

Western Operations Office, in Santa Monica, Calif., manages NASA contracts, performs technical monitoring and admin headquarters on technical developments and capabilities.



Growing Need for Avionics Speeds Uses

By Kenneth J. Stein

Changing patterns of technology may restrict their influence on the direction of avionics developments in the coming year, reverting the swing that last year placed emphasis on trading considerations.

At the aerospace industry has become increasingly avionics oriented, it has required the services of advanced, high speed data processors, more comprehensive and precise navigation gear, supplemented communications and transponders, expandable multi-channel telemetry, and specialized input and output functions.

Electronics problems have evolved rapidly and substantially to meet the requirements of a continuing process of evolution that has seen avionics design concepts develop to levels of capability and reliability compatible with the overall demands of the user.

In effect, the changing technology needs to shift the emphasis of the user toward hardware.

A need to upgrade the quality of design concepts was identified by the advent of solid-state memory and the inherent reliability of the transistor. Newer techniques, such as semiconductor

effects and other environmental conditions in space. In the case of the *Rebel* 1 satellite, for example, the weak link proved to be a wholly unexpected effect of extremely low temperatures on one critical transistor (AW Dec. 9, p. 55).

Operating temperatures and pressures may have been culprit causes in other avionics. Current knowledge of the properties of the space environment and of the components and subsystems that may be exposed to it may be expected to lead to a more realistic appraisal of the parameters that must be measured to give meaningful projections of life expectancy.

With increasing use of semiconductor technologies, internal connections may become a new area of critical focus. Interconnections have already been a source of design problems, which may have diminished the need for solid-state components but have not been a major concern based on the Advanced Microsystem program (AW Oct. 28, p. 79).

Solutions to these and similar problems will be forthcoming with increased application of semiconductor

microcircuits, and current figures indicate that this scenario is rapidly developing.

Sales of semiconductor microcircuits increased in the third quarter of 1963 to \$4.3 million, a factor of almost three, compared with \$1.4 million average quarterly sales for all of 1962. Ship orders are expected to pump further west year.

Emphasis on command and control system constraints to expand, rendered by the recent disclosure by USAF's Electronic Systems Div. of a new System Development Laboratory, headed by General G. Blasius, Field, Baden, Mo.

The laboratory, to be operated by Electronic Systems Div. and the contractor Micro Corp., will be to concerned and control systems what a wind tunnel is to aerofoils, one official said. The facility will make use of an IBM 7070 (Stretch) computer and of rooms which may be reconfigured as command posts for various nations under test to evaluate future command and control system concepts.

Current experiments will deal with improving communication between command and data processing units, which will be the first step in developing two-way commanding programming of computers and translation of information into machine language. Future USAF testing

systems are expected to benefit by the semiconductors techniques, which are considered to affect future requirements for aircraft equipment.

An application for the optical study (based in a means of detecting clear air turbulence through a laser radar technique which might detect shear, air discontinuities, not detectable by RF) in this class has been proposed. Sestini at Martin-Marietta speculate that the laser might provide sufficient reflection to laser energy.

In another application of the laser, USAF plans to test the device as a ground-to-ground communications link.

Changing patterns are anticipated in conflict areas since aircraft avionics equipment according to code lines established by Special Committee 100 of the Radio Technical Commission for Aeronautics.

Proposed in the form of a process list for avionics equipment for various classes of aircraft, the RTCA report considers the need of an radio control and navigation in relation to Federal Aviation Agency plans for the future. On this basis, it establishes an order of priority for various equipment.

Equipment elements required, depending on the class of aircraft, will include:

- VHF communications
- VOR navigation, supplemented by

distance measuring equipment (DME) or ATC transponders, supplemented by TACAN transponders, if required.

• Off-set course capability from VOR/DME by means of position display or course line selection.

The contractor wants what it calls "several obvious" elements from the list, because they are not considered elements of the basic navigation and ATC systems, although they may be useful and functional. These revisions, and the reasons given for them are:

- Instrument Landing Systems (ILS), facilities for which are currently provided only at major terminal concentrations. 75% of the total number of ILS are not equipped with DME. Also, aircraft not equipped with ILS receivers can make ILS approaches through the use of other aids, the RTCA says. It calls ILS research a user's option.
- Marker facilities, for which the need is expected to decrease in future, particularly at DME, is expanded. Also, with regard to available for determining fixes, the committee says.

- Automatic direction finders (ADF), present in "extremely useful and necessary equipment in certain areas." However, use of the ADF as primary navigation equipment is expected to decline in the future, and, for this reason, it is not listed in the required category, according to the RTCA.



MARTIN H-37B FLYING FULLY-AUTOMATIC. low-level terrain avoidance system appears to maintain a constant altitude over rolling terrain in this series of rapid sequence photographs. Aircraft approached simulated target over low hills far right of the Fangs Lake area in New York state, then swept over the village. Cornell Aeronautical Laboratories, Buffalo, N.Y., developed the system, which it calls Autoland, under contract from USAF Aeromatic Systems Div., Wright-Patterson AFB. Cornell's contract includes evaluation of

advanced radar control systems and data processing techniques through ground simulations and flight experiments. Cornell has been working in what it calls the terrain following field for more than 10 yr. Its work was presented to the President's Scientific Advisory Committee, along with other photographs. Pilot was John C. Seal of Cornell. Edward C. Schwartz, project engineer, monitored the equipment. Photographer used a Heliader 70 mm camera at five frames/sec.

Manufacturers Review Component Buying

By Evelyn J. Bellon

Dulles, Tex.—Business flying is continuing its steady upward pace as a fast growing segment of the U.S. aerospace manufacturing and sales industry.

This year's production will probably run 600-700 more units than the 6,700 turned out in 1962, with a dollar volume approximately \$15 million to \$20 million higher than last year's \$185 million total value, the Aerospace Industries Assn. estimates. Industry leaders see no let down in sight for next year.

Already the largest user of U.S. aircraft in number—80,000 aircraft versus approximately 1,000 scheduled airways and 32,700 private aircraft—the private air fleet will gradually increase this decade in just a few years, the Federal Aviation Agency estimates. In five years, 99,000 general aviation airplanes will be sharing the airspace over this country with approximately 35,000 airline and military types, the agency forecasts. Standard business aircraft industry sources believe FAA figures are on the conservative side.

Boeing production continues towards dual-jet aircraft. Better equipped, more costly single and two-engine aircraft. In five years, multi-engine business airplanes will outnumber scheduled aircraft by nearly 12 to 1, FAA forecasts.

Growing sophistication in business aircraft and their component parts will be further essential as the coming year with deliveries starting of the new class of light jets, christened by the Aero Jet Commander and the Lear Jet. The development, though several years behind the scheduled, will affect aircraft manufacturers, parts suppliers and aircraft maintenance facilities, although its impact probably will not be clear until 1965. Some wise observers believe it plausible that the business aircraft jet fleet could number 3,500 units in the next decade.

The overall business fleet is an indication of where purchases are developing. The aircraft builders are turning to larger and larger volumes of parts purchased from outside, but with the aircraft manufacturer's role as a source of parts and maintenance facilities steadily vanishing. The aircraft parts manufacturer is attempting to meet this demand.

Competition in new product lines will definitely increase as additional suppliers tend to sink their share of the available business. From the aircraft manufacturer's standpoint, he will be increasingly critical of quality and reliability and is looking more and more at the product as a system, rather than as an airplane carrying a collection of equipment.

Indications are that the aircraft builders are becoming less tolerant to

market similar items under his own trade name, often to the detriment of the same airplane. Then there are major distributors of these parts less and equipment manufacturers who are trying to live out a share of this market and are also increasing competition.

Even aside from new parts, because these distributors are often the distributor's only source, they are not usually family size figures. But 18 manufacturers of one distributor's association are doing approximately \$7 million monthly supplying the needs of aircraft and fixed base operators, with probably less than half of that dollar volume in air line sales.

A typical large parts and accessories distributor, Southwest Aerospace Corp., expects to do about \$4 million in business in its 1964 fiscal year, half of this in the general aviation market. The nation's largest distributor, American Aviation Components, covers 15 states, represents 100 aircraft manufacturers and has a local sales office in its home base of Love Field, Dallas. Southwest Aerospace estimates it has about 1,000 customers in its territory and these can range in volume from \$200 per month to as much as \$50,000 monthly for bigger accounts.

The distributor has been gearing for the buildup in the general aviation market in recent years. At one time, approximately 50-55% of its volume was with established users.

Aerospace manufacturers for both aircraft and equipment manufacturers are developing a network of additional sales outlets to be able to reach those prospects and provide the airplanes that are flying with greater safety by making sure all rolling and service facilities available.

It is already apparent that such facilities have not kept pace with the growth of the industry. Hangar space is at a premium. A recent Boeing survey showed that the bulk of this country's general aviation aircraft are built in the north central states. But the north central aircraft growth is located in 400 communities, all of which have populations of 75,000 or less. But at airports at these locations there were approximately 21 airports for every 100,000 people, or storage hangars.

Also, a detailed Census survey, completed this year, pointed out that there were only 13,594 certified fixed base operators against a total of over 10,000 airports, indicating a dearth of operation. Considering that intended airports averaged 2.5 operators, this means that several thousand airports lack adequate sales, service and maintenance facilities.



AERO COMMANDER'S Jet Commander (above) is shown with added 30-in. fairing section forward of the engine cowls, lengthening fuselage to 50 ft. 11 in. Gross weight of the aircraft has been increased to 36,000 lb., allowing an increase in useful load to 8,700 lb. Jet Commander is powered by General Electric CJ610 turbines. Upper wing leading edge is equipped with speed brakes.



NORTH AMERICAN SABRELINER (above) is shown during low-level turn with gear, flaps and speed brakes extended. Aircraft is powered by two Pratt & Whitney JT12A-3 engines. Boeing 727 (below) has engine nacelles modified for the General Electric CF700 turbines. Note Pan American World Airways markings on tail. Pan Am ordered 40 McDonnell Douglas 727s in U.S. with engines by CF700 series. Douglas said in U.S. will have U.S.-built communications and leading gear components.





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AMP

For a brief description of the products listed below, see the following pages:

- Coaxial cable and shielded wire products
- Pin and socket multiple connectors
- Programming devices
- Printed circuit connectors
- Toker technique
- Hermetically sealed connectors
- Application tooling

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COAXICON[®] CONNECTORS

A complete line of multiple and single-hole connectors for coaxial cable covering RG58 cable sizes 0.075" to 2.50". Termination is made with a crimp or solder. AMP[®] crimp tool terminals—see spoke of the marketing AMP[®] crimp tool terminals—inter conductor, outer shield and cable support—insure terminality. Contact plating—AMP standard gold over nickel—assures maximum conductivity and long time reliability.

TERMHASHIELD[®] SPLICES AND FERRULES

Selection includes pre-terminated insulated types for both single and multiple conductors. Choice of vinyl and TEFLO[®] insulation. Included are special heat-shielded handles and specially designed pre-insulated ferrules for use with pre-insulated heat-shielded single and multiple conductors. These provide maximum conductivity, high temperature resistance, maximum insulation, and a tensile strength approaching that of the wire itself.



MINIATURE Type IV Connectors
12 and 20 positions



STANDARD Type IV
20 and 30 positions



AMP-INCIDE[®] crimp tool
Model for multi conductor
termination of MIL-C-1608



Standard MIL-D-24349[®]
standard and multi conductor
tools for multiple wire insulation

AMP-INCIDE[®] Printed Circuit Connectors are available in 12 and 20 positions. Standard and miniature types. Standard connectors are not pre-insulated—only those insulations necessary to meet circuit requirements need be used. Special contact

designs insulate contacts from ground. Reduces wear on circuit boards. Insulated contacts are available for crimping contacts available in choice of handle, semi-automatic and fully automatic types. Contacts feature gold over nickel plating.



AMP-INCIDE[®] CONNECTORS
12, 18, 24, 30, 42, 60, 100 positions
Conforms to MIL-D-24349



AMP-INCIDE[®] CONNECTORS
20-piece right angle connector
9 to 20 positions



AMP-INCIDE[®] CONNECTORS
9 to 20 positions



AMP-INCIDE[®] CONNECTORS
9 to 20 positions

PIN AND SOCKET MULTIPLE CONNECTORS



ance data. We have a wealth of such data at United States Steel, plus comparative design studies, that will make your material problems easier. Ask for a USS cryogenics specialist by calling our nearest sales office, or writing United States Steel, Room 6834, 525 William Penn Place, Pittsburgh, Pennsylvania 15230.



100% nickel-9% nickel steel vessel was manufactured for the primary air exhaust of two steam-driven compressors. The vessel is made of stainless steel.



81% nickel-18% nickel steel insulation vessel, which is the primary air exhaust of two steam-driven compressors. The vessel is made of stainless steel.



Type 304 stainless steel insulation jackets on exhaust exhaust and check resistances of air-cooled compressors operating at -320°F.

USS 9% Nickel Steel: excellent strength and notch toughness down to -320°F

Developed, tested, and proven for cryogenic use, USS 9% nickel steel offers a rare combination of high yield strength, toughness, and notchability. It is particularly suited for large bearing supports, pressure vessels, piping, and tank structures used in the transportation of liquid oxygen, liquid nitrogen, liquid helium, liquid hydrogen, and argon. Because it doesn't require stress relief after fabrication or heat cycle. Furthermore, it is a natural for large field-erected tanks and vessels.

The ASME allowable working stress of 30,000 psi (Code Case 3065) is more than double that of 18,000 psi permitted the aluminum alloy 6063-T6. These thicknesses can be reduced to less than half those of aluminum with no sacrifice in stress at 100 percent load.

For example, tested and compared by ASTM A203 Grades D and E, Allowable design stresses are 16,350 psi and 17,000 psi, respectively. These sheets are covered under AS 3, 203, A36M Binder and Pressure Vessel Code.

USS 9% nickel steel is a natural alternative for aluminum. In case of aluminum results in considerable savings, data accumulated in static margin savings of at least 10% of final cost compared to aluminum vessels.

USS 31% Nickel Steel: used for land-based facilities and ocean-going tankers

The austenitic chromium nickel stainless steel sheets 31%Ni and 304L, are by far the most popular materials for cryogenic service down to less than -300°F. They are used widely in liquid oxygen production and storage, and the storage of liquid hydrogen, liquid helium, and argon. Wherever high purity is essential, such as handling liquid monatomic fluids, stainless is a must because its surface remains chemically clean and won't settle dust.

With 300 stainless steel it is easy to weld, braze, and forge, design for stress relief, vibration, and pressure load, and possess high strength with excellent stability and shock resistance at very low temperatures. Its allowable design stress is 18,700 psi.

USS and "USS" are registered trademarks.



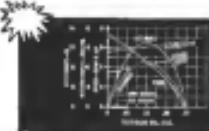
United States Steel

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CUSTOM DESIGN LINE
of SERVO MOTORS





TYPE NUMBER	Torque			Speed			Avail. Model	Avail. Use	Weight
	Peak (lb-in)	Rated (lb-in)	Actual (lb-in)	Peak (RPM)	Rated (RPM)	Actual (RPM)			
4000-1/2A	38	25	248	118	85	85	4000	25	1.85
4001-1/2A	40	25	240	125	85	85	4000	25	2.00
4002-1/2A	35	40	30	91	235	232	3000	15	2.00
4003-1/2A	26	35	120	248	379	379	3000	15	2.00
4004-1/2A	26	35	120	248	379	379	3000	15	2.00

Weight: 1.85 lb.

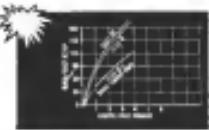
Rotating: 1.85 lb.

Starting: 2.00 lb.

Brake torque: 1.85 lb.

Brake current: 4.0A.

The torque efficiency of the above servo motors has not yet been plug-in tested.



TYPE NUMBER	Torque			Speed			Avail. Model	Avail. Use	Weight
	Peak (lb-in)	Rated (lb-in)	Actual (lb-in)	Peak (RPM)	Rated (RPM)	Actual (RPM)			
4000-1/2A	0.48	0.367	4.3	4.2	71,000	71,200	26	26	1.15
4001-1/2A	0.16	0.361	3.7	1.7	75,000	75,000	26	26	0.76
4002-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
4003-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
4004-1/2A	0.21	0.164	2.6	3.4	90,000	12,100	26	26	0.76
4005-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4006-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4007-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56

Weight: 1.15 lb.

Rotating: 1.15 lb.

Starting: 1.15 lb.

Brake torque: 1.15 lb.

Brake current: 4.0A.

The torque efficiency of the above servo motors has not yet been plug-in tested.



TYPE NUMBER	Torque			Speed			Avail. Model	Avail. Use	Weight
	Peak (lb-in)	Rated (lb-in)	Actual (lb-in)	Peak (RPM)	Rated (RPM)	Actual (RPM)			
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4002-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
4003-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
4004-1/2A	0.21	0.164	2.6	3.4	90,000	12,100	26	26	0.76
4005-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4006-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4007-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56

Weight: 0.76 lb.

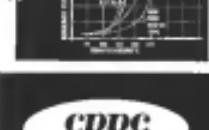
Rotating: 0.76 lb.

Starting: 0.76 lb.

Brake torque: 0.76 lb.

Brake current: 4.0A.

The torque efficiency of the above servo motors has not yet been plug-in tested.



TYPE NUMBER	Torque			Speed			Avail. Model	Avail. Use	Weight
	Peak (lb-in)	Rated (lb-in)	Actual (lb-in)	Peak (RPM)	Rated (RPM)	Actual (RPM)			
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4002-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
4003-1/2A	0.24	0.184	2.7	3.7	400,000	74,800	26	26	0.76
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4005-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4006-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56
4007-1/2A	0.05	0.164	2.0	1.6	110,000	5,400	26	26	0.56

Weight: 0.56 lb.

Rotating: 0.56 lb.

Starting: 0.56 lb.

Brake torque: 0.56 lb.

Brake current: 4.0A.

The torque efficiency of the above servo motors has not yet been plug-in tested.

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of SYNCHROS AND ROTATING COMPONENTS



SYNCHROS

Sizes 6, 10, 11, 18 and 22 are available. Delco synchros offer highest economy in production cost and 10° maximum error at 10°/sec. Input shafts, tapered roller shafts, continuous insulation of insulation, stainless steel or aluminum housings. Delco sealed shells, Delco high temperature resistors (95°F) types are available. DFTC offers an extremely wide variety of synchros as Translators, Rotators, Control Translators, Differential Translators.

ROTATING COMPONENTS



GYRO PICK-OFF RESOLVERS

Gyro pick-offs generally require individual motor drives, magnifiers and winded potentiometers. DFTC can furnish designs from four standard models. However, stainless steel, no bearing housing, a wide selection of frame stock lengths, width and diameters are also available. Turn-around time is 6 weeks.



PRECISION COMPUTING RECEIVERS

Sizes 6, 10 and 11. Highest accuracy and lowest noise level. Input impedance is 100 ohms. Excellent noise, low phase shift. Gyrator input provides high impedance. Our receiver is designed to work with wide range of load impedances. Input resistances: 100 ohms, 1000 ohms, 10,000 ohms. Output resistances: 100 ohms, 1000 ohms, 10,000 ohms. Wide variety of temperature compensated resistors available.



LINEAR TRANSFORMERS

Delco Linear Transformers 6, 10, 11, 18 and 22. Design is to within a single, standard housing. Input and output resistances are also available. Solid alignment - another Delco trademark. Gyrator input uses 100 ohms. Output resistances: 100 ohms, 1000 ohms, 10,000 ohms. Wide variety of temperature compensated resistors available. The entire package is designed to resist high temperatures.



GEAR HEAD MOTORS

Sizes 6, 10 and 22. In DFTC a specialized product. For gear heads to within a single, standard housing. Input and output resistances are also available. Solid alignment - another Delco trademark. Gyrator input uses 100 ohms. Output resistances: 100 ohms, 1000 ohms, 10,000 ohms. Wide variety of temperature compensated resistors available. The entire package is designed to resist high temperatures.

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They aren't supposed to. ■ Like this helmet-mounted radio receiver for field communications. Or this compact miniature transmitter. ■ The U.S. Army Electronics Research and Development Laboratories, Ft. Monmouth, New Jersey, have constructed for these new all-transistor units for service first use. For the first time, communications travel with the squad, lighten the load that soldiers must take into battle, and—in many cases—provide the

means to send messages by doing away with hand signals or shouted commands. Fighting men are able to react to orders instantly—regardless of their field positions, the size of their units, or the combat conditions surrounding them.

■ Delco Radio puts whenever instantaneous-perfect communications systems can help solve a problem. ■ Perhaps we can help solve yours. Forward your specifications to Delco Radio, Military Requirements Department, Kokomo, Ind.

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RADIO**



...comes through head heat unscathed!

Higher and higher recording speeds mean instrumentation progress—and problems! Increased speed and tension on tape generates friction that concentrates heat around recording heads and can make ordinary tape unreliable. Signal dropout or distortion can result when this localized, high-temperature, build-up separates recording oxide from tape backing.

"SCOTCH" BRAND Heavy Duty Instrumentation Tapes carry signals easily through heat-treated environments. They withstand temperatures from -40°F up to +250°F. They last at 15 times longer than ordinary tapes. Their heavy duty oxides and binders are formulated to meet heat extremes, minimize robots. Exclusive Silicene lubrication eases head wear, tape wear. They offer 1000 times more conductivity.



Magnetic Products Division **3M**

Chris Hunter 109 at Butler Senior Care

13

ANNOUNCING FS-X-750

**HIGH NICKEL
ALLOY BY
FIRE-STEAMING**



... EXTREMELY CLEAN, SOUND AND FINE GRAINED, WITH GOOD FORGEABILITY, WELDABILITY AND MACHINABILITY CHARACTERISTICS.



Felt Sterling's new high temperature alloy FSA 750 is produced by the exclusive Hopkins Process of consumable electrode melting under a flux blanket which minimizes non-metallic inclusions—so important in critical applications such as jet engines, missiles and nuclear power mechanisms. You get a high quality metal, practically free of segregation, requiring less heat treating. So you can order material closer to finished use and save three ways . . . on small cast, shipping cost and machining cost. And because of its unusually clean, fine grained structure, FSA 750 is readily forgeable, weldable and machinable. Available in ingots, billets, bars, rod and wire.

Chemical analysis: C—0.6%, Mn—7.0%; Cr—15%; Ni—7.3%; Ti—2.50%; Al—8.0%; Co—8.0%; Fe—6.75%.

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卷之三十一

Air Force Titan III-C Gets
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OF HIGH
RELIABILITY

D6AC ROCKET MOTOR Casing Ring
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To Previous Page for
Specs, Features and Data



There is No Substitute for Reliability

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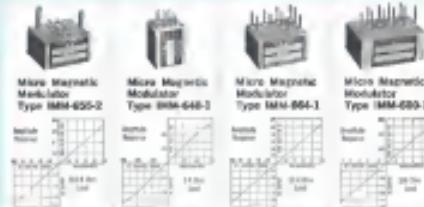
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Low milliwatt power consumption



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Reference Carrier Position Accuracy	± 1.0% (0.0010 in)			
Input-Output Dynamic Range	± 10 to 1000 mV DC			
± 10% of Input DC Input Working	± 10% of Input			
± 10% of Output DC Output Working	± 10% of Output			
± 10% of Input Linearity over 1000 mV	± 10% (0.0010 in)			
All Output Data Resolution (1000 mV)	0.01 mV (0.0001 in)			
Input Impedance	1000 ohms	1000 ohms	1000 ohms	1000 ohms
Internal Load	100 ohms	100 ohms	100 ohms	100 ohms
Conversion Efficiency Working (1000 mV)	± 10% (0.0010 in)			
Output Power Rating (Average Power)	± 10% (0.0010 in)			
Dynamic Linearity (0.0010 in)	0.01% Max	0.01% Max	0.01% Max	0.01% Max
% Dynamic Error, in Direct Parallel Mode	± 10%	± 10%	± 10%	± 10%
Temperature Range	-50° to 125° C			
Frequency Response	0.01 to 1000 Hz			
Overall Frequency (0.0010 in)	± 10% (0.0010 in)	± 10% (0.0010 in)	± 10% (0.0010 in)	± 10% (0.0010 in)
Type of Housing	Two 2.50" Shells	Two 2.50" Shells	Two 2.50" Shells	Two 2.50" Shells
Appropriate Mounting Options	S/F	S/L	S/R	S/L

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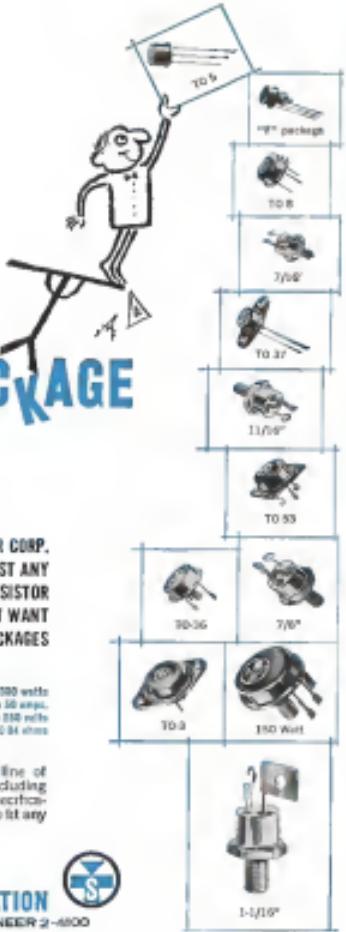
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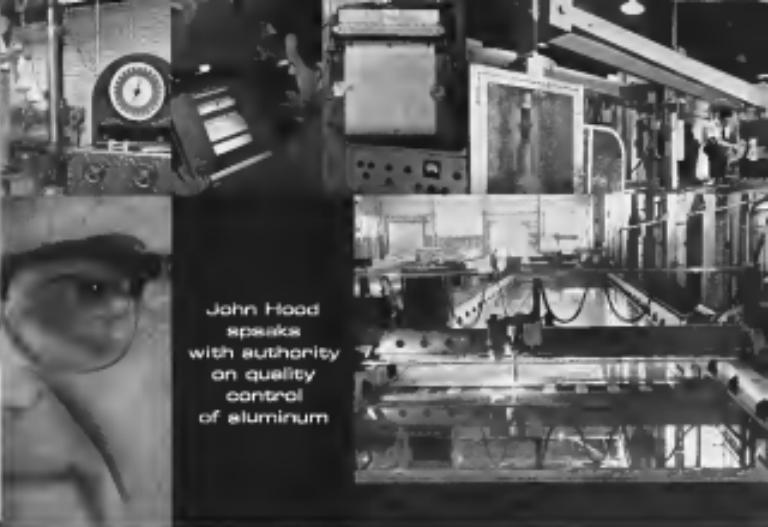
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John Hood
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One day early in 1952, representatives of six airplane manufacturers met in Pittsburgh with John Hood and 14 other Alcoa metallurgists. John was then head of the Quality Standards Department of the Alcoa Metallurgical Division. He and the others had gathered to begin setting up industry-wide standards for ultrasonic inspection of aluminum.

Alcoa was there because it was the leader in industry to employ ultrasonic inspection methods, having started in 1945. Under John's direction, 73 units are now in service at Alcoa facilities producing ingot, forgings, plate and extrusions. Result? Flaws which had formerly enjoyed the privacy of nondetection can now be identified. This gives Alcoa the information needed to improve manufacturing techniques and furnish products of higher integrity. This, in turn, lowers manufacturing costs for customers.

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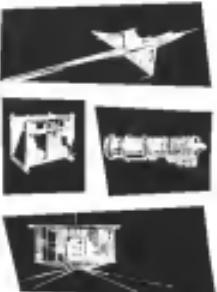
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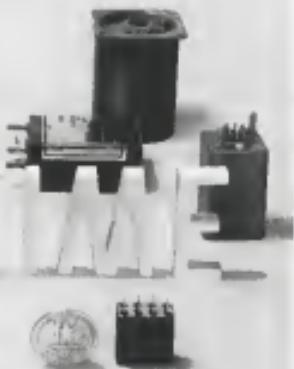
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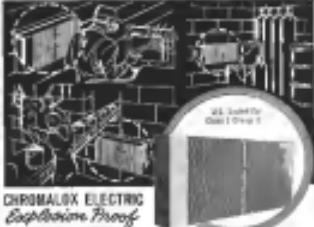
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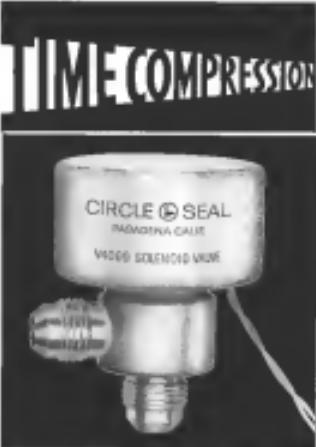
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Solar simulators at Spectrolab are big business. Under way right now is the final assembly of three large solar simulators to be used in competition with various chambers for the testing of satellite components and structures. And at the same time, the Spectrolab Model X-25 Solar Simulator, a new laboratory instrument, is being built on a production line. In yet another area, a research staff is developing a plasma arc-heated radiative re-entry simulator.

In optical design and fabrication, Spectrolab has concentrated on developing its ability to take on jobs that other people have avoided. Large parabolic mirrors, achromatic ultra-violet filters, and deep atmospheric lenses, are typical products. Metal mirrors, made by electro forming techniques, are in regular production.

Spectrolab multi-layer dielectric filters have sold throughout the world for laboratory and field experiments in solar physics. Most recently, a selected group of filters was combined with the Spectrolab Model 3D-100 Rocket Photometer System for a high altitude solar energy measurement probe. Other new developments include narrow bandpass filters (1.5-8.0 Å) for IGY solar applications.

For more information on these programs and other activities of Spectrolab, contact Spectrolab Field Engineering Department, 23084 Gladstone Avenue, Los Gatos, California.



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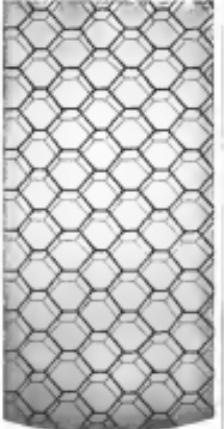
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Creating such a special unit takes ingenuity and experience. Beece has "off the shelf" boats and vehicles that answer most requirements of airborne or G-E installations. But if necessary, Beece can design, manufacture, and test the "problem child" you need . . . effectively and fast.



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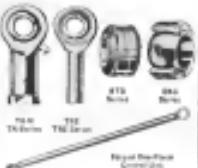
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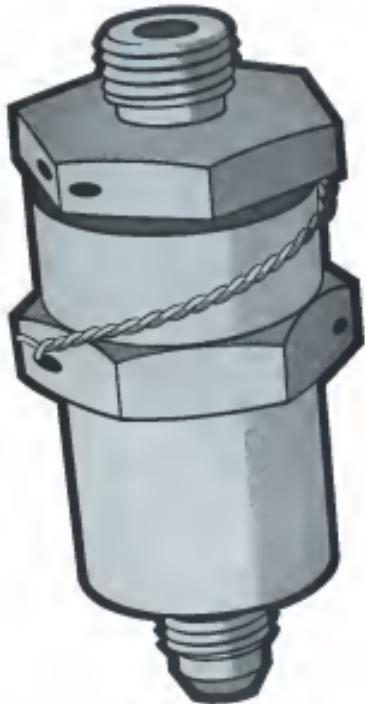
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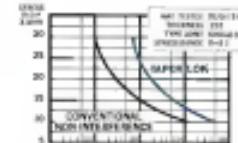
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- **POSITIVE SEALING** without the use of supplementary washers.
- **PHENOMENAL STRUCTURAL FATIGUE LIFE** as proven by over 81,000,000.00 m testing by major aircraft producers.



This graph illustrates the fatigue life (number of cycles to failure) resulting from the use of the TAPER-LOK controlled interference fastener in a typical angle shear load test. Fatigue life is measured in stress cycles.

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